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Sir:

Transmitted herewith for filing is the (X) utility,  
( ) design, ( ) plant patent application of:

Inventor(s): Toshiaki Kanemitsu et al

For: METHOD OF MANUFACTURING AN ANNULAR MEMBER MADE OF A METAL  
SHEET HAVING A PERIPHERAL WALL

Enclosed are:

(X) 16 page(s) of specification (X) Abstract

(X) Executed Declaration/Power of Attorney

(X) 10 sheet(s) of (X) formal ( ) informal drawings

(X) An Assignment of the application to \_\_\_\_\_  
Kabushiki Kaisha Kanemitsu

( ) Preliminary Amendment

( ) Information  
Disclosure Statement

( ) Associate Power of Attorney

(X) Verified Statement Under  
37 CFR 1.9 and 1.27

The filing fee is calculated as follows:

| CLAIMS AS FILED          |                 |                 |            |            |          |
|--------------------------|-----------------|-----------------|------------|------------|----------|
| FOR                      | NUMBER<br>FILED | NUMBER<br>EXTRA | RATE       |            | AMOUNT   |
|                          |                 |                 | LG. ENTITY | SM. ENTITY |          |
| Basic Fee                | XXXXX           | XXXXX           | \$790.00   | \$395.00   | \$395.00 |
| Utility                  |                 |                 |            |            |          |
| Design                   | XXXXX           | XXXXX           | \$330.00   | \$165.00   |          |
| Plant                    | XXXXX           | XXXXX           | \$540.00   | \$270.00   |          |
| Total Claims             | 6-20=           |                 | x\$ 22.00  | x\$ 11.00  |          |
| Independent              |                 |                 |            |            |          |
| Claims                   | 1-3=            |                 | x\$ 82.00  | x\$ 41.00  |          |
| Multiple Dependency      |                 |                 | \$270.00   | \$135.00   |          |
| Late Fee Surcharge       |                 |                 | \$130.00   | \$ 65.00   |          |
| Non-English Language Fee |                 |                 | \$130.00   | \$130.00   |          |
| Assignment Recording Fee |                 |                 | \$ 40.00   | \$ 40.00   | \$ 40.00 |
| TOTAL FILING FEE         |                 |                 |            |            | \$435.00 |

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jc408 U.S. PTO

jc518 U.S. PTO  
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(X) A check/ in the amount of \$435.00 to cover the filing fee is enclosed.

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( ) This application is filed under the provisions of 37 CFR 1.53, and does not include:

- ( ) Declaration
- ( ) Filing Fee

(X) The Commissioner is hereby authorized to charge payment of the following fees or credit any overpayment to Deposit Account No. 10-1213. A duplicate copy of this sheet is enclosed.

(X) Any addition filing fees required under 37 CFR 1.16.

(X) Any patent application processing fees under 37 CFR.

( ) The Issue Fee set in 37 CFR 1.18 at or before mailing of the Notice of Allowance, pursuant to 37 CFR 1.311(b).

(X) Priority is claimed under 35 USC 119 based on the following:

| Serial No.      | Date Filed             | Country      |
|-----------------|------------------------|--------------|
| <u>9-272676</u> | <u>October 6, 1997</u> | <u>Japan</u> |
| _____           | _____                  | _____        |
| _____           | _____                  | _____        |

(X) Certified copy (copies) enclosed.

Date: September 21, 1998

Respectfully submitted,

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Applicant or Patentee: Kabushiki Kaisha Kanemitsu Attorney's  
Serial or Patent No.: \_\_\_\_\_ Docket No.: \_\_\_\_\_  
Filed or Issued: \_\_\_\_\_  
For: METHOD OF MANUFACTURING AN ANNULAR MEMBER MADE OF  
A METAL SHEET HAVING A PERIPHERAL WALL

VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY  
STATUS (37 CFR 1.9 (f) and 1.27 (c)) — SMALL BUSINESS CONCERN

I hereby declare that I am

- ☐ the owner of the small business concern identified below:  
☒ an official of the small business concern empowered to act on behalf of the concern identified below:

NAME OF CONCERN Kabushiki Kaisha Kanemitsu  
ADDRESS OF CONCERN 20-26, Ookurahonmachi, Akashi-shi, Hyogo-ken, Japan

I hereby declare that the above identified small business concern qualifies as a small business concern as defined in 13 CFR 121.3-18, and reproduced in 37 CFR 1.9 (d), for purposes of paying reduced fees under section 41(a) and (b) of Title 35, United States Code, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third party or parties controls or has the power to control both.

I hereby declare that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention, entitled METHOD OF MANUFACTURING AN ANNULAR MEMBER  
MADE OF A METAL SHEET HAVING A PERIPHERAL WALL by inventor(s)  
Toshiaki KANEMITSU, Kurihiro HARADA and Naoki FUJII described in

- ☒ the specification filed herewith  
☐ application serial no. \_\_\_\_\_, filed \_\_\_\_\_  
☐ patent no. \_\_\_\_\_, issued \_\_\_\_\_

If the rights held by the above identified small business concern are not exclusive, each individual, concern or organization having rights to the invention is listed below\* and no rights to the invention are held by any person, other than the inventor, who could not qualify as a small business concern under 37 CFR 1.9 (d) or by any concern which would not qualify as a small business concern under 37 CFR 1.9 (d) or a nonprofit organization under 37 CFR 1.9 (e).

\*NOTE: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27)

NAME \_\_\_\_\_  
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I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28 (b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

NAME OF PERSON SIGNING Yukio KANEMITSU  
TITLE OF PERSON OTHER THAN OWNER President  
ADDRESS OF PERSON SIGNING 1-40, Kasumigaoka 7-chome, Tarumi-ku,  
Kobe-shi, Hyogo-ken, Japan

SIGNATURE YUKIO KANEMITSU DATE 14/9/1998

**TITLE OF THE INVENTION**

**Method of Manufacturing an Annular Member Made of a Metal Sheet  
Having a Peripheral Wall**

**5 BACKGROUND OF THE INVENTION****1. Field of the Invention**

10 The present invention relates to a method of manufacturing an annular member made of a metal sheet used for a pulley or the like, particularly, an annular member made of a metal sheet having a peripheral wall, the peripheral wall has a shape of protruding to either side of a plate-like base portion surrounded by the peripheral wall.

**15 2. Description of the Prior Art**

A conventional method of manufacturing this kind of annular member made of a metal sheet, is schematically shown in Figs. 13 to 15. According to the manufacturing method, a disc-shaped material 1 made of the metal sheet, having a predetermined thickness T3 shown in Fig. 13, is employed thereby manufacturing the member. In other words, the material 1 is held between a pair of dies not shown in Figures, thereby rotating the material 1 with the dies, while, against an axial center portion of an outer periphery of the material 1 as shown in Fig. 14, a roller 25 2 for splitting the outer periphery of the material is pressed

to split the outer periphery of the material in a forked state, thereby forming a splitting portion 3. As shown in Fig. 15, against the splitting portion 3, a forming roller 4 is pressed, thus forming a peripheral wall 6 protruded on both sides of a non-processed portion 5.

However, according to the conventional manufacturing method described in Figs. 13 to 15, the outer periphery of the material 1 is split, thereby forming the splitting portion 3 which is axially extended to form the peripheral wall 6. As a result, a thickness T3 of the disc-shaped material 1 made of the metal sheet is required to be at least 2 or more times a thickness required to the peripheral wall 6. In other words, it is required to employ the thick material 1 before forming the peripheral wall 6 of the determined thickness T4, and the thickness T3 of the non-processed portion 5 has the same measurements as the thickness T3 of the original material 1 whereby there is a problem wherein it is difficult to achieve a produced annular member having a light weight.

Moreover, it is difficult that a thickness T4 of the peripheral wall 6 is finished so as to be larger than the thickness T3 of the non-processed portion 5. In order to finish it as mentioned above, there has been a problem wherein a thickness disposal of the peripheral wall in a post step must be additionally conducted.

**SUMMARY OF THE INVENTION**

The present invention has been conducted in view of the above mentioned problems and circumstances. According to the present invention, a thin disc-shaped material made of a metal sheet is employed to make it possible to form a peripheral wall. Accordingly, the object of the present invention is to provide a manufacturing method of the annular member made of a metal sheet, having the peripheral wall, easily leading to the annular member to be produced being lightweight.

In addition, another object of the present invention is to provide a manufacturing method of an annular member made of a metal sheet, having a peripheral wall, which can make the peripheral wall thinner or thicker than a non-processed portion.

A method of manufacturing an annular member made of a metal sheet having a peripheral wall according to the present invention, comprises the steps of:

rotating a disc-shaped material made of a metal sheet, pressing an outer periphery of the material in a radially inward direction, while rotating the material, thickening the outer periphery axially by pressing it, protruding the outer periphery to either side of a non-processed portion of the material, and

forming a peripheral wall protruding to the either side of the non-processed portion.

The present invention is not a method wherein an outer periphery of the material is split before it is developed, thereby forming the peripheral wall, but a method wherein the outer periphery thereof is axially thickened while extending  
5 it to the both sides of the non-processed portion of the material, thus forming the peripheral wall. Accordingly, even if the material is too thin to be split, the outer periphery of the material can be formed as a peripheral wall protruded to the both sides of the non-processed portion. Additionally, there  
10 is formed a peripheral wall having a thickness corresponding to a radial width of the outer periphery of the material formed as the peripheral wall. Consequently, a width thereof is appropriately predetermined, thereby easily making it possible to make the peripheral wall thicker or thinner. As a result,  
15 it is also possible to thicken the peripheral wall more than the non-processed portion.

According to the present invention, in an intermediate phase of the step of thickening the outer periphery of the material axially, a preliminary peripheral wall may be formed  
20 so that the outer periphery thereof may have an axial center portion which is more outwardly protrusive than axial both ends, in an arc-shaped state. Thus, the outer periphery of the material is formed as the preliminary peripheral wall shaped as mentioned above, before forming it as the peripheral wall  
25 protruding to the both of the non-processed portion. As a

result, all steps from an initial forming step to a finishing step of finishing the outer periphery of the material into the peripheral wall thereof can be unforcedly conducted.

Moreover, according to the present invention, in advance  
5 of forming the preliminary peripheral wall, the outer periphery of the material may be formed so that a sectional face thereof may have a substantially circular shape. Thus, the outer periphery of the material is formed so that the sectional face thereof may have a substantially circular shape, before it is  
10 formed as the preliminary peripheral wall having the above shape. Thereafter, the peripheral wall protruding to the both sides of the non-processed portion is formed by stages, thereby enabling the steps from the initial forming step to the finishing step of finishing the outer periphery thereof into  
15 the peripheral wall thereof to be further unforcedly conducted. Herein, the above expression of "a sectional face thereof may have a substantially circular shape" includes cases wherein a sectional shape is an exact circle, a shell-shaped circle, and a distorted circle.

20 Moreover, preferably, the present invention adopts a method comprising the steps of:

holding the non-processed portion of the material between  
a pair of dies,

rotating the material with the dies,

25 pressing a forming surface of a forming roller against



the outer periphery of the material, and

rotating the forming roller together with the material.

In this case, the steps of forming the annular member having the peripheral wall of the disc-shaped material made of the

5 metal sheet can be unforcedly conducted.

Furthermore, preferably, the present invention includes a finishing step of finishing the preliminary peripheral wall protruding to either side of the non-processed portion, in a predetermined shape.

10 In case of adopting the manufacturing method, the preliminary peripheral wall can be finished so as to lead to the peripheral wall having an optional shape. As a result, for example, the outer peripheral surface of the peripheral wall can be finished so as to be axially flat or axially curved in  
15 an arc-shape, or a flange can be protruded to axial both ends of the peripheral wall, or a poly-V-groove can be formed on the outer peripheral surface of the peripheral wall.

Other features and effects of the present invention are further clarified by embodiments described as below.

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#### **BRIEF DESCRIPTION OF THE DRAWINGS**

Figs. 1A and 1B are diagrams of a chevron portion forming step of forming a chevron portion.

25 Figs. 2A and 2B are diagrams of a substantially circular portion forming step of forming a substantially circular

portion.

Figs. 3A and 3B are diagrams of a preliminary peripheral wall forming step of forming a preliminary peripheral wall.

5 Figs. 4A and 4B are diagrams of a rough peripheral wall forming step of forming a rough wall.

Figs. 5A and 5B are diagrams of a peripheral wall forming step of forming a peripheral wall (i.e., a finishing step).

Fig. 6 is an enlarged sectional view of the chevron portion.

10 Fig. 7 is an enlarged sectional view of the substantially circular portion.

Fig. 8 is an enlarged sectional view of the preliminary peripheral wall.

15 Fig. 9 is an enlarged sectional view of the rough peripheral wall.

Fig. 10 is an enlarged sectional view of the peripheral wall.

Fig. 11 is an enlarged sectional view of a peripheral wall according to a modification.

20 Fig. 12 is an enlarged sectional view of a peripheral wall according to another modification.

Fig. 13 is a partially sectional view of a material employed in a conventional method.

25 Fig. 14 is a diagram of a slitting step of slitting the material, according to the conventional method.

Fig. 15 is a diagram of a peripheral wall forming step of forming a peripheral wall according to the conventional method.

## 5 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawing, a preferred embodiment of the invention is described below.

10 Figs. 1 to 5 are diagrams showing each step of the embodiment of a manufacturing method according to the present invention.

Figs. 6 to 10 are diagrams showing a section of the outer periphery of the material formed by the each step.

15 In this embodiment, a disc-shaped material 10 made of metal sheet is previously subject to a drawing process, whereby as shown in Fig. 1A, a swelling portion 11 having a circular shape and a flange portion 12 around it are concentrically disposed. A center of the swelling portion 11 having the circular shape is provided with a round hole 13 formed by piercing. The round hole 13 can be employed as a fixing hole  
20 for fixing it in a shaft of a rotary rod or the like.

As shown in Fig. 1A, in the disk-shape material 10 made of a metal sheet, inner portion between the swelling portion 11 and the flange portion 12 is decided as a non-processed portion 14. A process for forming a peripheral wall 21 (see  
25 Fig. 5B) is applied to an outer periphery 15 of an outside of

the non-processed portion 14. A radial width of the outer periphery 15 is appropriately predetermined, taking an axial length and a thickness of the peripheral wall 21 (see Fig. 5B) to be formed into consideration.

5 As shown in Fig. 1A, the non-processed portion 14 of the material 10 is held between a pair of dies or an upper die 100 and a lower die 200, and the dies 100, 200 are rotated, thereby rotating the material 10 with the dies 100 and 200. The dies 100 and 200 are employed in common through all steps shown in  
10 Figs. 1 to 5. Additionally, a shape and a thickness T1 of the non-processed portion 14 of the material 10 are not substantially changed by conducting the whole steps.

As shown in Fig. 1A, a first forming roller 300 is disposed to be opposed to the outer periphery 15 of the material 10 held  
15 between the pair of dies 100, 200. A valley-shaped forming surface 310 expanded outwardly and included in the first forming roller 300 is moved from a radial outside to the outer periphery 15. As shown in an arrow "a" in Fig. 1B, the first forming roller 300 is advanced, thereby pressing the outer periphery 15 of the  
20 material 10 in a radially inward direction by means of the valley-shaped forming surface 310 (see Fig. 1A). Thereafter, the first forming roller 300 is rotated together with the material 10, the outer periphery 15 is radially reduced in rotation while it is axially thickened with the result that an  
25 shape having the same shaped outline as the valley-shaped

forming surface 310 is formed. Namely, a sectional chevron shape having a round top as enlarged and shown in Fig. 6 is formed. A chevron portion 16 having such a shape is annularly disposed around it so as to extend to either side of the non-processed  
5 portion 14.

In a next step, as shown in Fig. 2A, a second forming roller 400 is disposed to be opposed to the chevron portion 16. A semi-circular forming surface 410 disposed on the second forming roller 400 is moved from a radial outside to the chevron  
10 portion 16. As shown in an arrow "b" in Fig. 2B, the second forming roller 400 is advanced, thereby pressing the chevron portion 16 (see Fig. 2A) in a radially inward direction, on the semi-circular forming surface 410. Thereafter, the second forming roller 400 is rotated together therewith, whereby the  
15 chevron portion 16 is radially reduced in rotation while it is axially thickened, a shape having the same shaped outline as the semi-circular forming surface 410 is formed so that a sectional face thereof may have a substantially circular shape as enlarged and shown in Fig. 7. The substantially circular  
20 portion 16 formed as mentioned above is annularly disposed around the non-processed portion 14 so as to protrude to the both sides of the non-processed portion 14. The section of the substantially circular portion 16 may be exactly circular or shell-shaped though the shape of the substantially circular  
25 portion 16 in Fig. 7 is distorted.

In a next step, as shown in Fig. 3A, a third forming roller 500 is disposed so as to be opposed to a substantially circular portion 17, a shallow concave forming surface 510 included in the third forming roller 500 is moved from a radial outside to the substantially circular portion 17. As shown in an arrow "c" in Fig. 3B, the third forming roller 500 is advanced, the substantially circular portion 17 (see Fig. 3A) is pressed to a radially inward direction, by means of the concave forming surface 510, the third forming roller 500 is rotated together, the substantially circular portion 17 is radially reduced in rotation while it is axially thickened, with the result that a shape having the same shaped outline as the concave forming surface 510 is formed as a sectional preliminary peripheral wall 18 as enlarged and shown in Fig. 8. The preliminary peripheral wall 18 having such a shape is annularly disposed around it so as to extend to either side of the non-processed portion 14. The preliminary peripheral wall 18 as illustrated in Fig. 3A, is provided with flat portions 18a, 18a on the both ends in an axial direction, a swelling portion 18b having a small height is disposed on an axial central portion, which is situated more outwardly than the flat portions 18a, 18a, and the swelling portion 18b has a great curvature so as to swell in an arc-shape. The outer peripheral surface of the each flat portion 18a and the outer peripheral surface of the swelling portion 18b are smoothly continuous.

In a next step, as shown in Fig. 4A, a fourth forming roller 600 is disposed to be opposed to the preliminary peripheral wall 18, a groove-shaped forming surface 610 included in the fourth forming roller 600, whose bottom surface is flat and shallow, is moved from a radial outside to the preliminary peripheral wall 18. As shown in an arrow "d" in Fig. 4B, the fourth forming roller 600 is advanced, the preliminary peripheral wall 18 (see Fig. 4A) is pressed to a radially inward direction on the groove-shaped forming surface 610, thereby rotating the fourth forming roller 600 therewith, and mainly the swelling portion 18b (see Fig. 8) of the preliminary peripheral wall 18 is radially reduced in rotation, while, a whole of the preliminary peripheral wall 18 is slightly axially thickened. Consequently, a shape having the same shaped outline as the groove-shaped forming surface 610 is formed as a sectional rough peripheral wall 19 as enlarged and shown in Fig. 9, the rough peripheral wall portion 19 having such a shape is annularly disposed around it so as to extend to either side of the non-processed portion 14. As illustrated in the figure, the rough peripheral wall 19 is not yet well-finished because the shape of the end surfaces 19a, 19a of the axial both ends is rounded.

In a next step, as shown in Fig. 5A, a fifth forming roller 700 is disposed so as to be opposed to the rough peripheral wall 19, a groove-shaped forming surface 710 included in the fifth

forming roller 700, whose bottom surface is flat and shallow, is moved from the radial outside to the preliminary peripheral wall 19. The groove-shaped forming surface 710 has a shape enabling the end surfaces 19a, 19a of the rough peripheral wall 19 shown in Fig. 9 to be finished accurately, for example, a shape enabling the end surfaces 19a, 19a to be exactly shaped. As shown in an arrow "e" in Fig. 5B, the fifth forming roller 700 is advanced, the rough peripheral wall 19 (see Fig. 5A) is pressed in a radially inward direction on the groove-shaped forming surface 710, the fifth forming roller 700 is rotated together therewith, mainly the end surfaces 19a, 19a of the axial both edges of the rough peripheral wall 19 are formed in rotation so as to make a right angle with the outer peripheral surface, which are formed as the peripheral wall 21 having the same shaped outline as the groove-shaped forming surface 710. The peripheral wall 21 formed in such a manner, is annularly disposed around it, so as to protrude to the either side of the non-processed portion 14. The peripheral wall 21 formed in this manner has the both end surfaces which are exactly shaped as enlarged and shown in Fig. 10. The peripheral wall 21 is equally protruded to either side of the non-processed portion 14. The outer peripheral surface thereof is axially flat. A thickness T2 and an axial length of the peripheral wall 21 shown in Fig. 10 have each size fitted in a radial width of the outer periphery 15 of the original material 10.



According to the manufacturing method mentioned above, the rough peripheral wall 19 formed in the step of Fig. 4B, is finished by the finishing step of Fig. 5B, leading to the peripheral wall 21 having a high accuracy. Before the preliminary peripheral wall 18 formed in the step of Fig. 3B is finished leading to the peripheral wall 21, a step of forming the rough peripheral wall 19 is interposed. Also, the finishing step may be conducted immediately after the preliminary peripheral wall 18 is formed, thereby forming the peripheral wall 21. As the case may be, after a state wherein the non-processed portion 14 of the material 10 as shown in Fig. 1A is held between the pair of dies 100, 200, a step wherein the preliminary peripheral wall 18 is directly formed on the outer periphery 15 may be conducted. Alternatively, a step of forming directly the substantially circular portion 17 and a step of forming a preliminary peripheral wall 18 may be subsequently conducted. Additionally, there is also a case wherein a step of forming directly the peripheral wall 21 is conducted.

In the finishing step mentioned above, the peripheral wall 21 having the axial both end surfaces which are exactly shaped, is formed. However, the shape of the forming surface of the forming roller is changed, whereby it is also possible to form the peripheral wall 21 having the outer peripheral surface extended in an arc shape as shown in Fig. 11, or form

the peripheral wall 21 including the flanges 22, 22 protruded outwardly on the both ends in the axial direction as shown in Fig. 12.

The annular member having the sectional-shaped peripheral wall 21 shown in Figs. 10, 11 and 12 can be employed as a back side pulley for winding a flat belt. Moreover, though it is not shown in figures, a poly-V-groove may be disposed on the outer peripheral surface of the peripheral wall 21 in the finishing step. The annular member manufactured in such a way, may be employed as the poly-V-groove pulley for winding the poly-V-belt.

As mentioned above, not only in case that the disc-shaped material made of the metal sheet is originally thick, but also in case that the material is too thin to be split, the above manufacturing method makes it possible to form a peripheral wall having a necessary thickness, thereby having effect of facilitating the produced annular member to be lightweight. Moreover, regardless of the thickness of the non-processed portion, a remarkable effect of enabling the peripheral wall to be formed in a state of a desirable thickness can be achieved. Therefore, a back surface pulley for supporting a back surface of a belt, a pulley with a flange, a pole piece V-groove pulley or the like having light weight can be easily manufactured.

The entire disclosure of Japanese Patent Application No. 9-272676 filed on October 6, 1997 including specification,

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**WHAT IS CLAIMED IS:**

1. Method of manufacturing an annular member made of a metal sheet having a peripheral wall comprising the steps of:
- 5 rotating a disc-shaped material made of a metal sheet, pressing an outer periphery of the material in a radially inward direction, while rotating the material, thickening the outer periphery axially by pressing it, protruding the outer periphery to either side of a
- 10 non-processed portion of the material, and forming a peripheral wall protruding to the either side of the non-processed portion.
2. Method of manufacturing an annular member made of a metal sheet having a peripheral wall according to claim 1, wherein,
- 15 in an intermediate phase of the step of thickening the outer periphery of the material axially, a preliminary peripheral wall is formed so that the outer periphery may have an axial center portion which is more outwardly swelled than axial both
- 20 ends, so as to be arc-shaped.
3. Method of manufacturing an annular member made of a metal sheet having a peripheral wall according to claim 2, wherein, in advance of forming the preliminary peripheral wall, the outer
- 25 periphery of the material is formed so that a sectional face

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thereof may have a substantially circular shape.

4. Method of manufacturing an annular member made of a metal sheet having a peripheral wall according to claim 1, further comprising the steps of:

holding the non-processed portion of the material between a pair of dies,

rotating the material with the dies,

- pressing a forming surface of a forming roller against the outer periphery of the material, and

rotating the forming roller together with the material.

5. Method of manufacturing an annular member made of a metal sheet having a peripheral wall according to claim 4, wherein, in an intermediate phase of the step of thickening the outer periphery of the material axially, a preliminary peripheral wall is formed so that the outer periphery may have an axial center portion which is more outwardly swelled than axial both ends, so as to be arc-shaped.

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6. Method of manufacturing an annular member made of a metal sheet having a peripheral wall according to claim 5, wherein a finishing step of finishing the preliminary peripheral wall protruding to either side of the non-processed portion in a predetermined shape is included.

25

**ABSTRACT OF THE DISCLOSURE**

The present invention relates to a disc-shaped material made of a metal sheet, provided for manufacture of the pulley or the like. According to the present invention, even if the metal sheet is thin and light weight, the peripheral wall ensuring an enough strength can be formed, by following steps: rotating the material held between a pair of dies 100, 200, and pressing an outer periphery of the material by means of a forming roller 500, in a radially inward direction, thereby thickening axially the outer periphery of the material to be extended to both sides of a non-processed portion 14, thus forming the peripheral wall 21.

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Fig. 1A

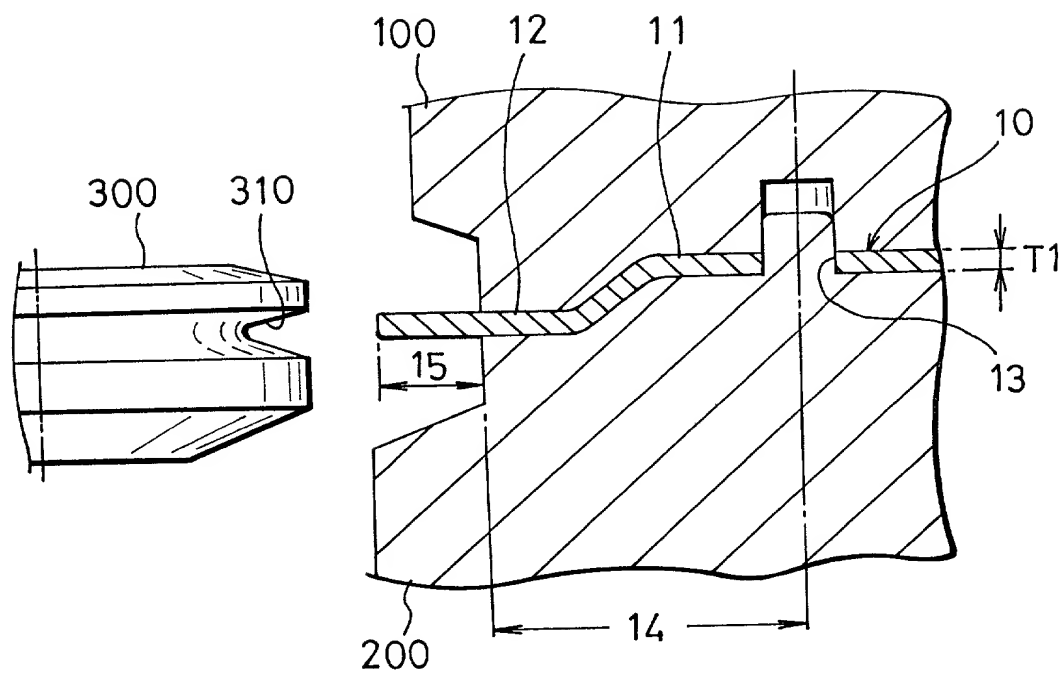


Fig. 1B

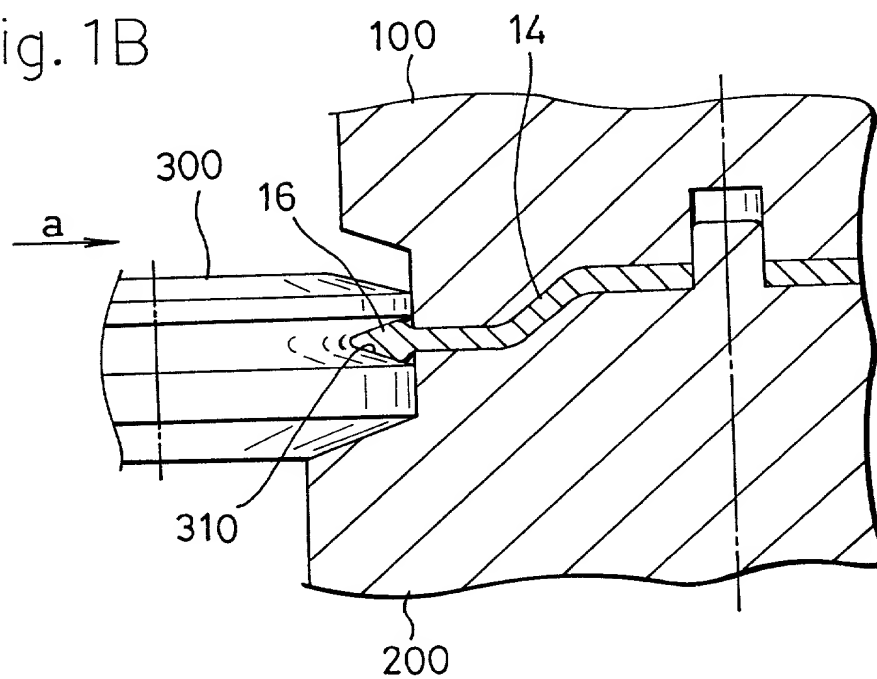


Fig. 2A

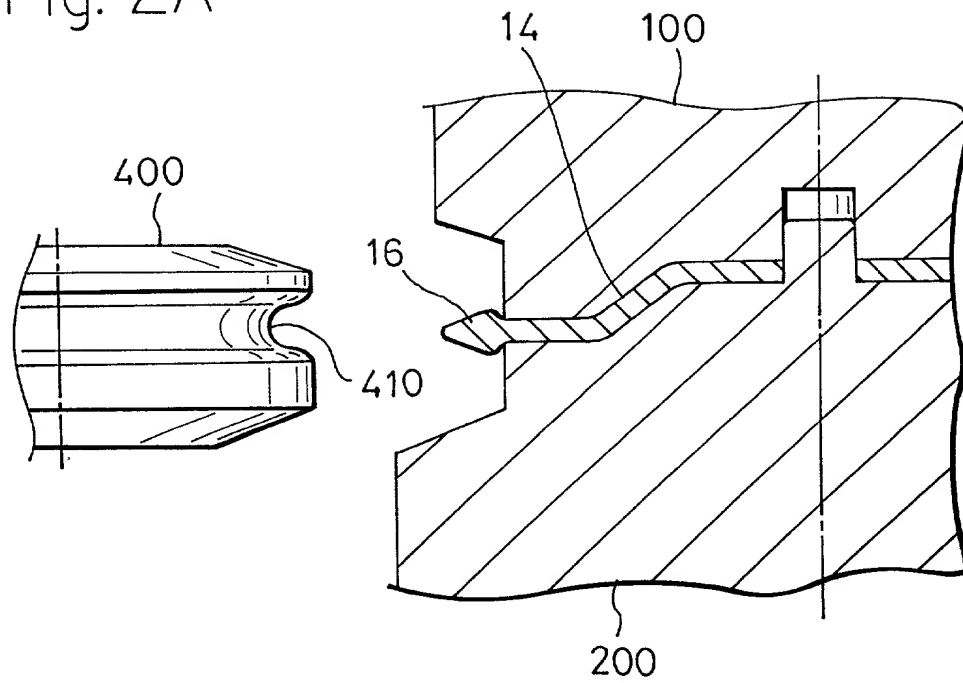


Fig. 2B

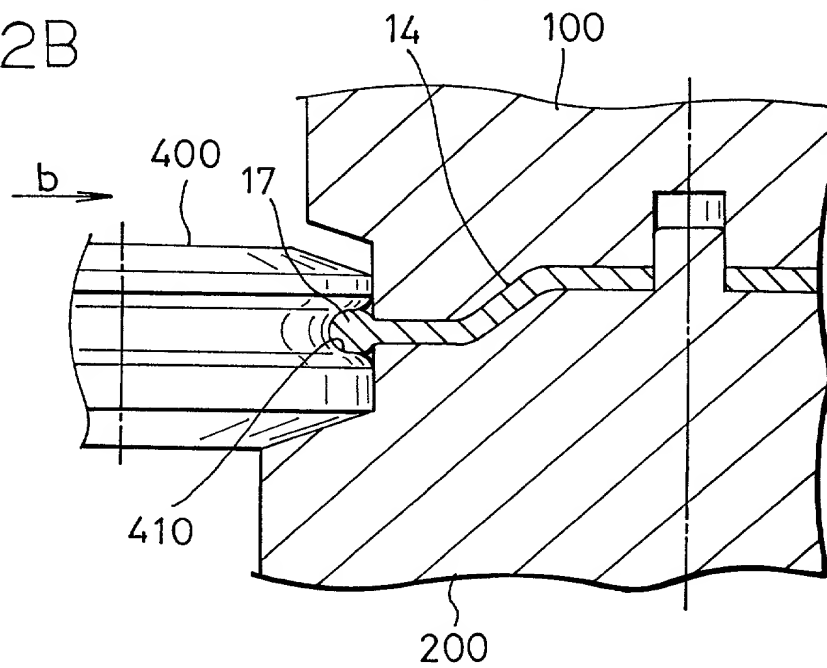




Fig. 3A

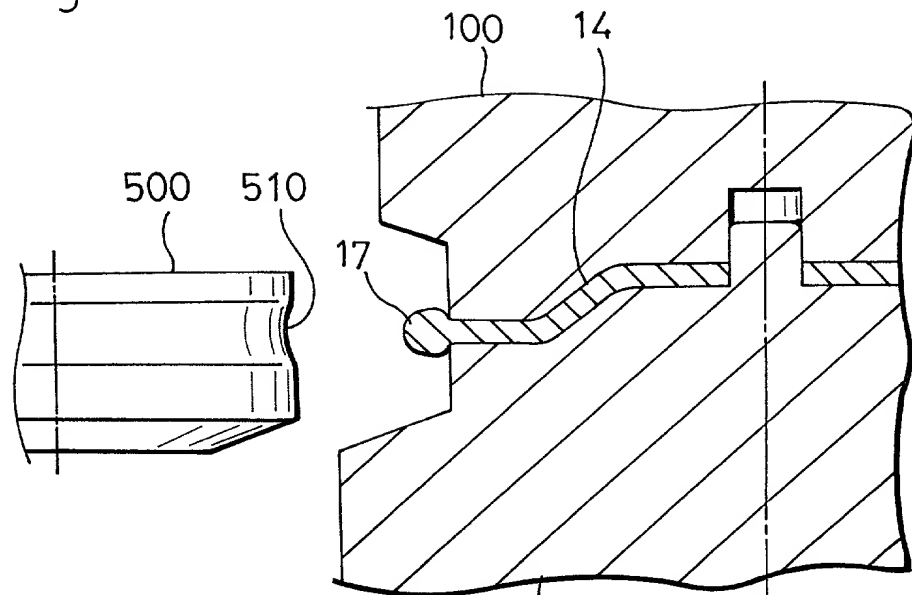


Fig. 3B

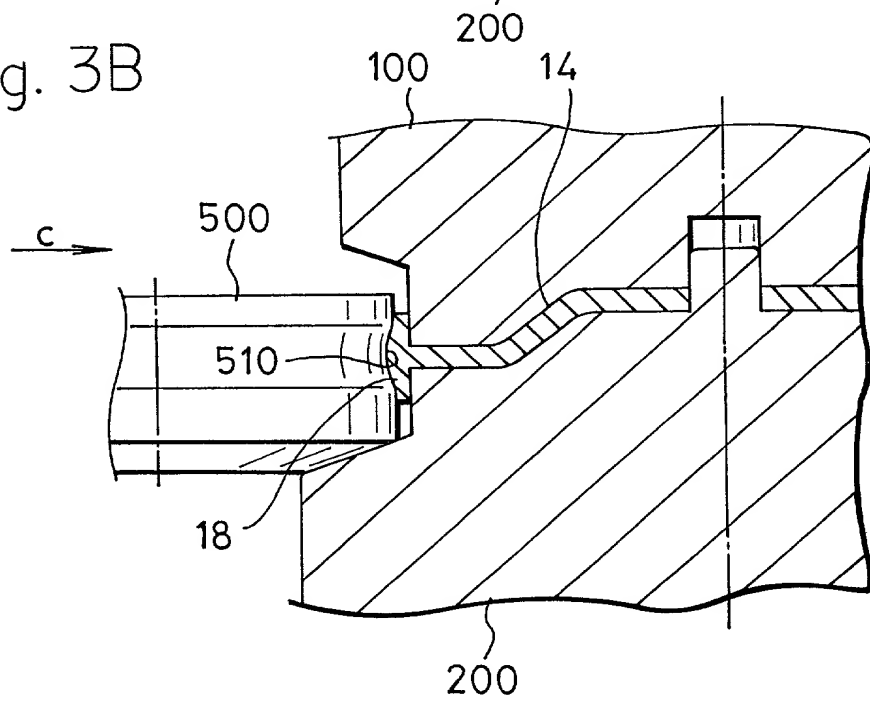


Fig. 4A

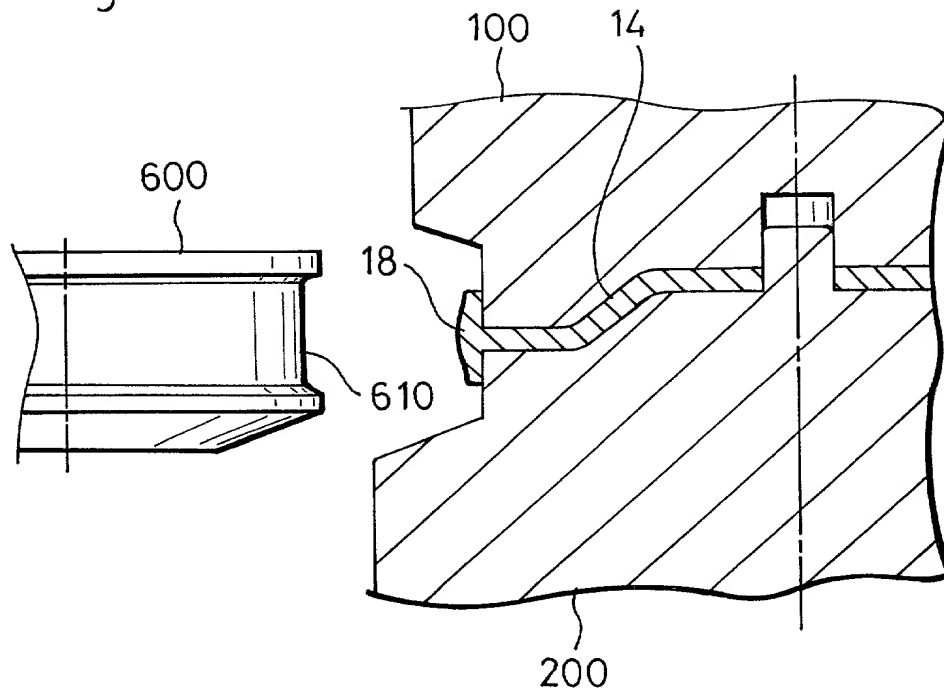


Fig. 4B

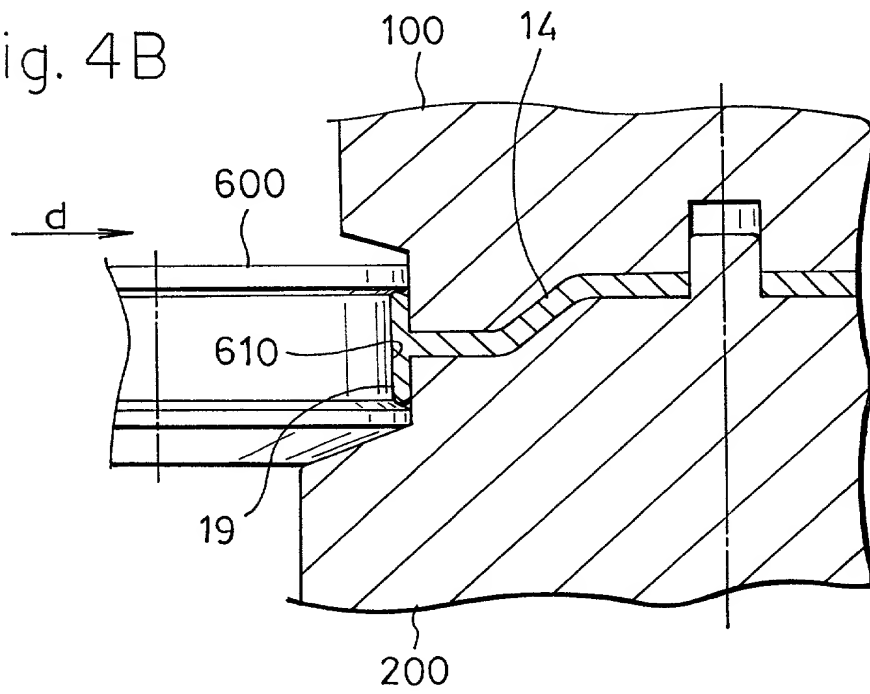


Fig. 5A

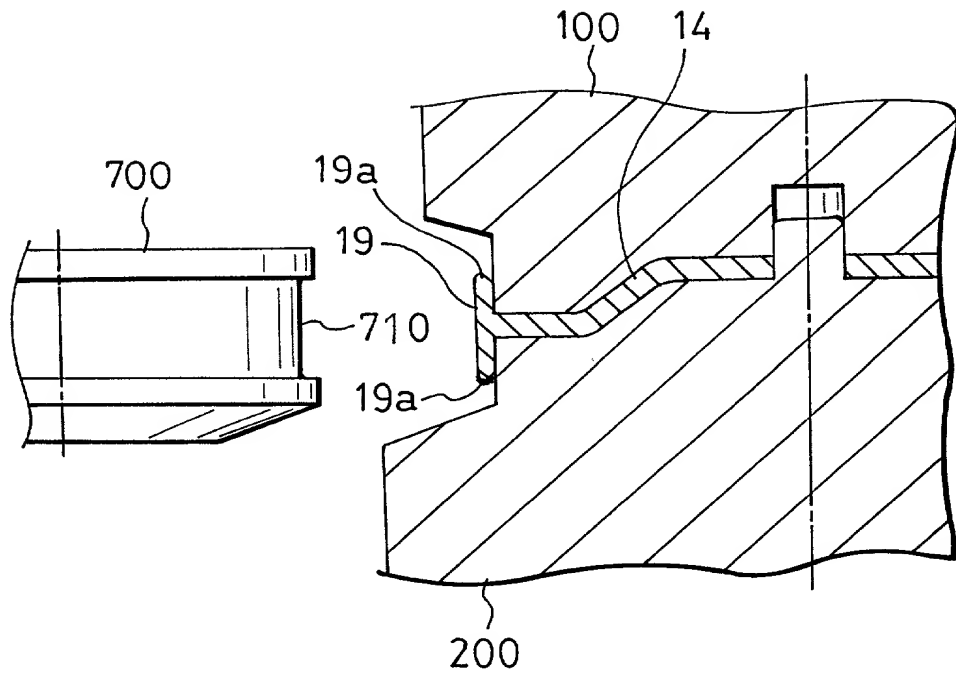


Fig. 5B

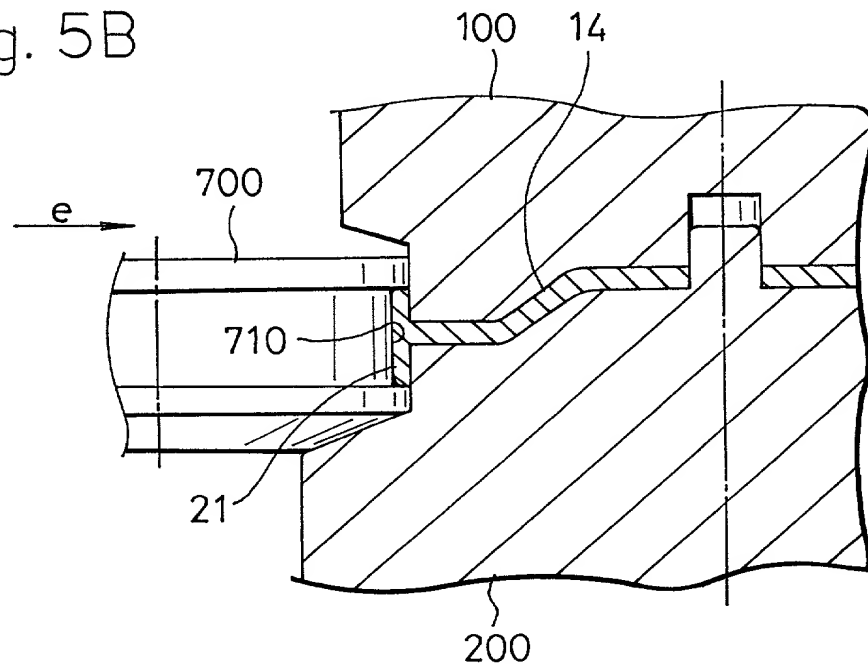


Fig. 6

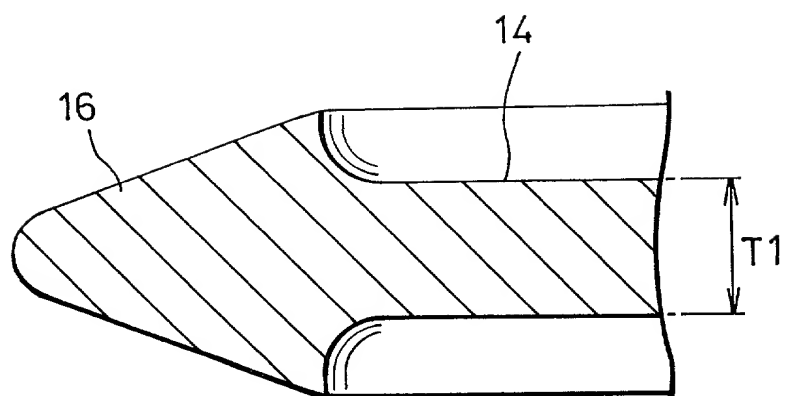


Fig. 7

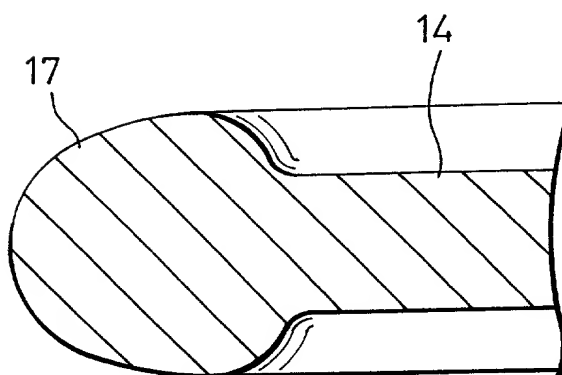


Fig. 8

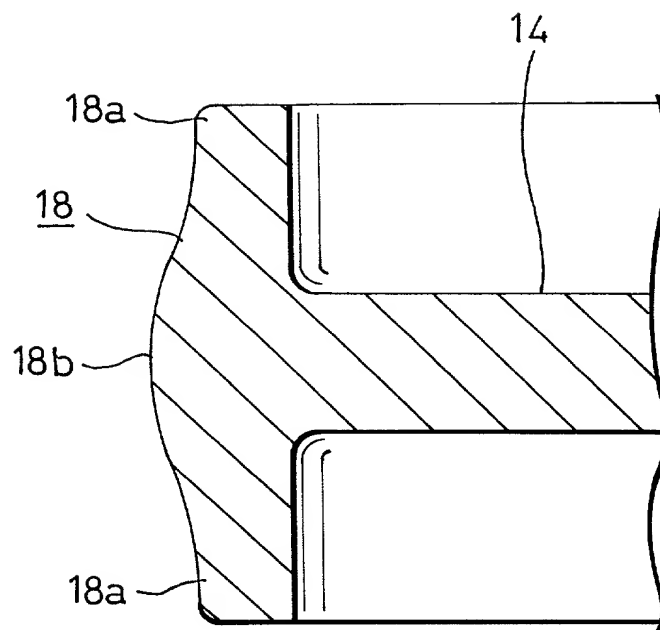


Fig. 9

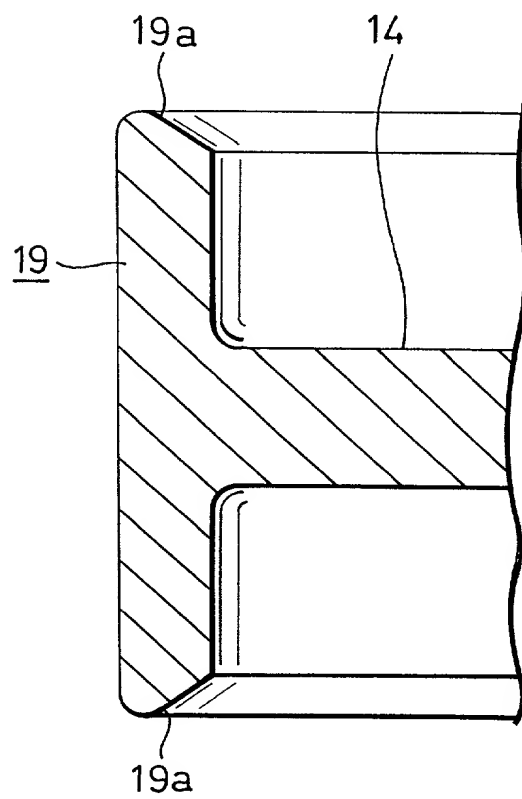


Fig. 10

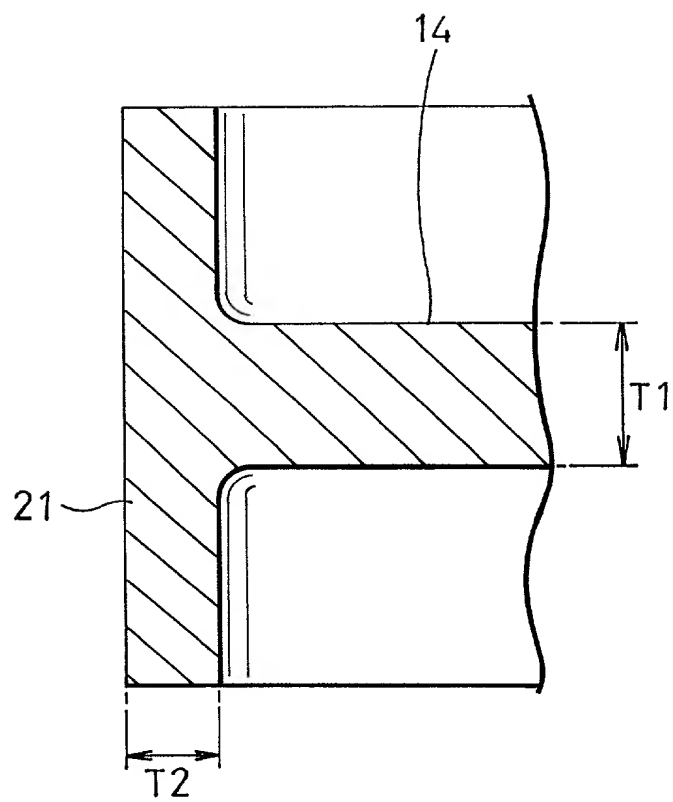
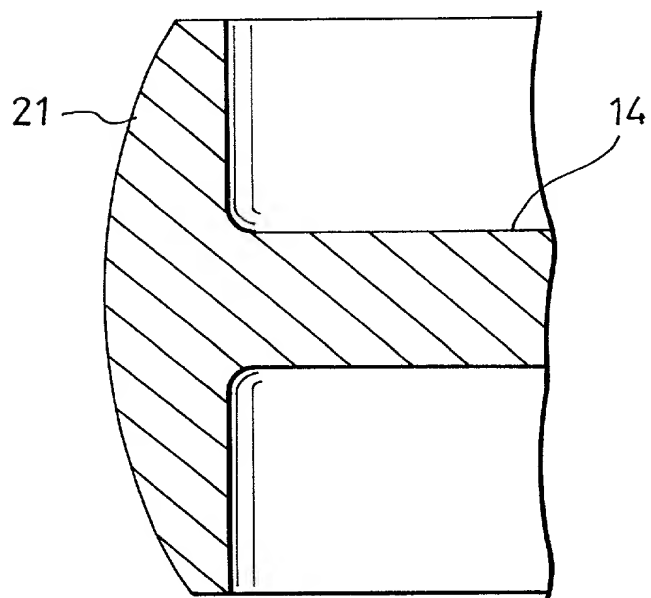


Fig. 11



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Fig. 12

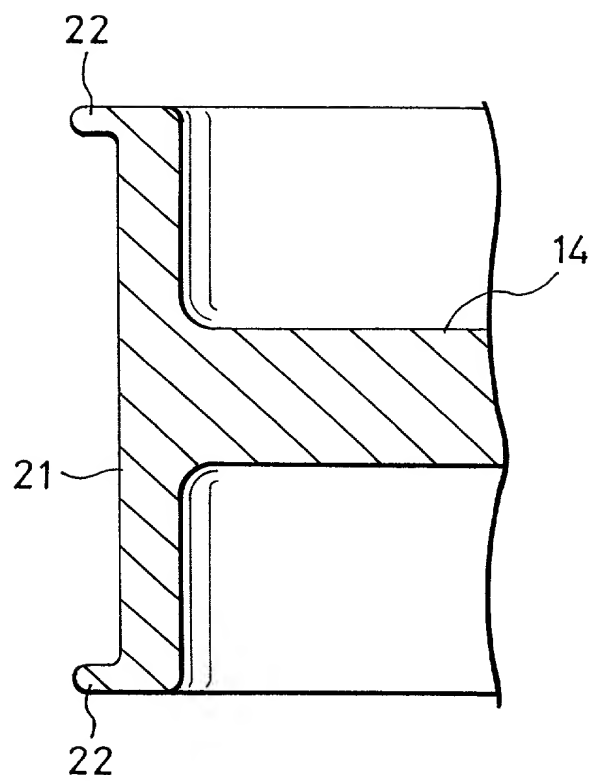


Fig. 13 (PRIOR ART)

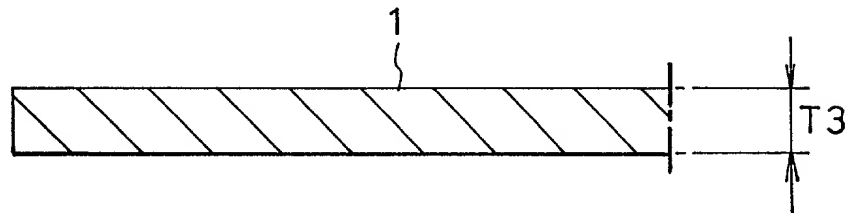


Fig. 14 (PRIOR ART)

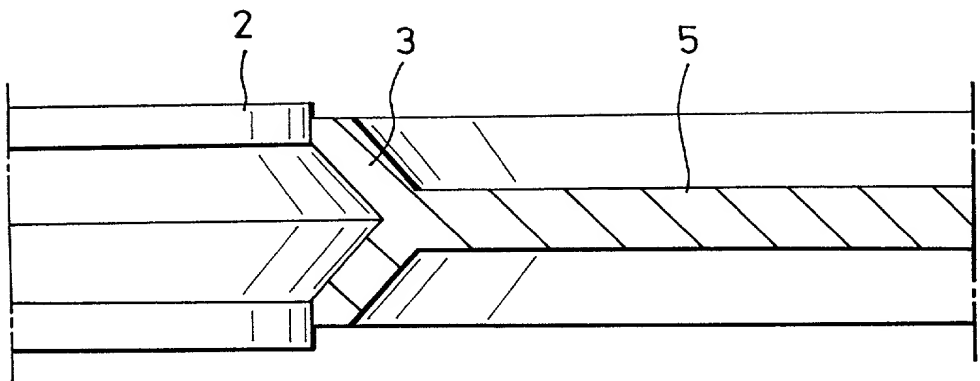
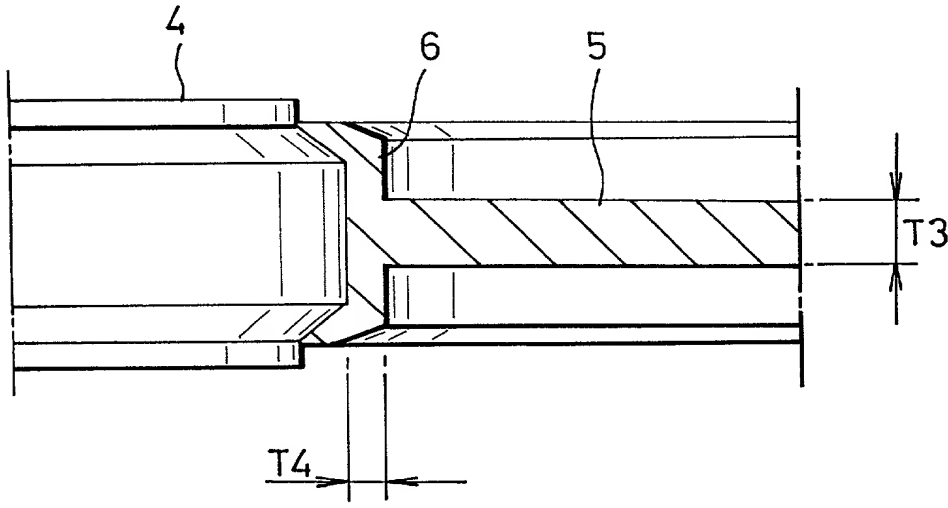


Fig. 15 (PRIOR ART)





COMBINED DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

This declaration is of the following type:

- ☒ original
- ☐ design
- ☐ supplemental
- ☐ national stage of PCT
- ☐ divisional
- ☐ continuation
- ☐ continuation-in-part (CIP)

My residence, post office address and citizenship are as stated next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed for and for which a patent is sought on the invention entitled:

METHOD OF MANUFACTURING AN ANNULAR MEMBER MADE OF  
A METAL SHEET HAVING A PERIPHERAL WALL

---

the specification of which

- ☒ is attached hereto
- ☐ was filed on \_\_\_\_\_, as  
Application Serial No. \_\_\_\_\_  
and was amended on \_\_\_\_\_  
(if applicable)
- ☐ was described and claimed in PCT International application  
No. \_\_\_\_\_ filed on \_\_\_\_\_  
and as amended under PCT Article 19 on \_\_\_\_\_  
(if any).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any Amendment referred to above.

I acknowledge duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Sec. 1.56.

- ☐ In compliance with this duty there is attached an information disclosure statement. 37 CFR 1.97.

2025 RELEASE UNDER E.O. 14176

I hereby claim foreign priority benefits under Title 35, United States Code, Sec. 119, of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent of inventor's certificate having a filing date before that of the application on which priority is claimed:

[ ] no such applications have been filed  
[X] such applications have been filed as follows.

Prior Foreign Application(s)

|          |           |                        |       |     |
|----------|-----------|------------------------|-------|-----|
| 9-272676 | Japan     | 6/10/1997              | [ X ] | [ ] |
| (Number) | (Country) | (day/month/year filed) | Yes   | No  |
| _____    | _____     | _____                  | [ ]   | [ ] |
| (Number) | (Country) | (day/month/year filed) | Yes   | No  |

I hereby claim the benefit under Title 35, United States Code, Sec. 120 of any United States application(s) listed below, and insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Sec. 112, I acknowledge the duty to disclose all information known to be material to patentability as defined in Title 37, Code of Federal Regulations, Sec. 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

|                          |               |                                |
|--------------------------|---------------|--------------------------------|
| _____                    | _____         | _____                          |
| (Application Serial No.) | (Filing Date) | (patented, pending, abandoned) |
| _____                    | _____         | _____                          |
| (Application Serial No.) | (Filing Date) | (patented, pending, abandoned) |

**POWER OF ATTORNEY:** As a named inventor, I hereby appoint the following attorney(s) and/or agents to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

|                                      |                                     |
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I hereby declare all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Inventor's signature \_\_\_\_\_ (Date)

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Citizenship \_\_\_\_\_

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